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HISTORY OF THE MK 49 WARHEAD (U)

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Weapon Systems

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Mk 49 Mod 3

(b)(1), (b)(3)

1/60	Mk 49 Mod 3 Warhead design released.
3/11/60	Mk 49 Mod 3 Warhead authorized for application to THOR and JUPITER missiles. Early production accomplished by retrofit of Mk 49 Mod 1 Warheads.
6/60	New production of Mk 49 Mod 3 Warheads.
8/16/61	Final evaluation report of Mk 49 Mod 1/3 Warheads accepted by Military.

Mk 49 Mod 4

10/3/58	XW-49-X1 Warhead proposed for use with ablation nose cones.
10/21/59	Proposed ordnance characteristics of XW-49-X1 presented to Special Weapons Development Board.

(b)(1), (b)(3)

4/26/60	Mk 49 Mod 4 design released and early production achieved.
10/4/63	Final development report of Mk 49 Mod 4 accepted by Field Command.

Mk 49 Mod 5

4/24/62	Division of Military Application requests Sandia to provide JUPITER warhead with permissive device to prevent unauthorized detonation.
9/25/62	Mk 49 Mod 5 design released, incorporating coded switch pack.
9/29/62	Mk 49 Mod 3 Warheads retrofitted to Mod 5.
5/64	Final evaluation report of Mod 5 published.

Mk 49 Mod 6

12/63	Authorization released to incorporate self-destruct unit into some Mk 49 Mod 3 Warheads.

3/64	Initial delivery of Mk 49 Mod 6 Warheads.
7/18/65	Final evaluation report of Mod 6 accepted by Field Command.

History of the Mk 49 Warhead

In mid-1956, Los Alamos Scientific Laboratory and Sandia started to investigate warhead designs that could be used in connection with ATLAS and TITAN intercontinental ballistic missiles and JUPITER and THOR intermediate-range ballistic missiles. These studies culminated in development of the XW-35 and XW-35-X1 Warheads.

(b)(1), (b)(3)

The XW-35-X1 was a new configuration designed to produce a higher yield per pound, and was to follow the XW-35 in development by about one year.

Due to delays in missile availability, it became apparent that the XW-35-X1 would become operational at the same time as the earliest of the above missiles (with exception of JUPITER) and that the XW-35 design could be canceled.

(b)(1), (b)(3)

A decision was then made to cancel the XW-35, use the modified XW-28 for JUPITER, and apply the XW-35-X1 to all four missiles.

(b)(3)

Since THOR and JUPITER squadrons were scheduled for deployment in late 1958 and the XW-35-X1 Warhead would not be available in time, modified Mk 28Y1 Warheads would be supplied for the interim period.[1]

A meeting with General Electric, designers of the nose cone for the ATLAS, TITAN and THOR, was held December 9, 1957, and it was noted that the modified Mk 28Y1 Warhead would be renamed the XW-49.[2] This warhead would contain no internal power, as this would be supplied by the missile adaption kit. It was felt that the XW-49 could be produced in 1958.

(b)(1), (b)(3)

(b)(1), (b)(3) The warhead would be sealed and pressurized. The firing system would be checked after assembly and subsequently require only continuity and pressure monitoring in field or stockpile. There would be no component replacement permitted and no reason to break the warhead seal after initial assembly.[1]

The Mk 49 Mod 0 Warhead was design released in March 1958,[3] and early units entered stockpile in September 1958.[4] Sandia presented Report SC4161(TR), Description and Status Report at Design Release of the W49-0 Warhead, to the April 23, 1958 meeting of the Special Weapons Development Board.[5] The report noted that the Mk 49 Mod 0 was a thermonuclear warhead designed for early-emergency-capability use in JUPITER and THOR missiles. The warhead was 20 inches in diameter and 54.2 inches in length, exclusive of mounting provisions.

(b)(1), (b)(3) Field testing was limited to monitoring the internal warhead pressure every 30 days and checking electrical continuity just before mating the warhead to missile re-entry vehicle.

The report noted that the Mk 49 Mod 0 was the first warhead system to use a rotary chopper inverter/converter to change low-voltage direct current (28 volts) into high-voltage direct current (2200 volts). When proper signals were applied to both chopper and converter, the applied voltage was interrupted, transformed, rectified and used to charge the X-unit capacitor storage bank. To complete arming functions, a low-voltage direct current was applied to boosting-gas reservoir and valve assembly to release deuterium-tritium gas into the sealed pit.

The Mk 49 Mod 0 Warhead could be fired by either one of two signals. The air-burst option applied a 28-volt direct-current signal to a high-turns-ratio, low-impedance pulse transformer. The stepped-up voltage was applied to one probe of a dual-probe spark gap, ionizing the gap and releasing energy stored in the X-unit capacitor bank to the detonators, firing the warhead.

In the contact-burst option, a 250-volt direct-current signal was developed by contact crystals and applied to the grid of a cold-cathode thyratron trigger tube, causing the tube to conduct. This discharged the capacitor in the plate circuit through the primary of the pulse transformer, and voltage generated in the secondary was applied to the second probe of the spark gap. This ionized the gap, the capacitor bank discharged into the detonators, and the warhead detonated.

(b)(1), (b)(3)

The firing system included X-unit, trigger circuit, rotary choppers, converter, arm/safe switch, and filter package. The boosting-gas reservoir and valve were mounted within the warhead pressure container. This container, composed of warhead case and pressure cover, housed warhead components and protected them from storage and operational environments. A pressure switch and humidity indicator were provided within the container to monitor internal pressure and humidity.

(b)(1), (b)(3)

Based on relative results of these two tests, and the fact that the nuclear testing moratorium was approaching, Los Alamos proposed, June 16, 1958, that the XW-35 program be canceled in favor of the XW-49. This suggestion was approved by the Division of Military Application, July 3, 1958.[7]

The United States Atomic Energy Commission wrote to the Deputy Secretary of Defense, July 8, 1958, reporting the decision to abandon the XW-35 program in favor of the XW-49.

(b)(1), (b)(3)

Sandia notified Albuquerque Operations Office, July 17, 1958, that the Mk 49Y1 Mod 0 Warhead would be delivered to stockpile in the near future. However, it did not appear appropriate to make the release until an acceptable number of successful warhead flights had been completed in various missiles. Schedules called for four THOR systems flights, and three system and two component flights in JUPITER by late 1958; and these would be the bare minimum to support an application release of warhead and missile. However, before the end of 1958, Sandia would issue an emergency-capability release to permit warhead-missile deployment pending availability of adequate flight-test information.[10]

An amended release of the Mk 49Y1 Mod 0 Warhead was made August 29, 1958. It was noted that satisfactory tests of this warhead had been performed in simulated environments typical of JUPITER and THOR, and application release for use in these missiles was authorized.[11]

By April 29, 1959, three warheads had been flight tested on THOR. Flight data indicated that the warhead experienced a relatively mild environment and that the warheads functioned as intended, in both air and contact burst. Six warheads had been tested on JUPITER. Of these, one test was successful, two were unsuccessful due to missile failure, two unsuccessful due to nose-cone failure, and one unsuccessful due to fuzing-system failure. Despite this poor showing, it was noted that these warheads had also experienced a relatively mild environment and that the weapons would have functioned properly if the correct fuzing signal had been given.[12]

The Mk 49Y2 Mod 0 Warhead was released July 2, 1959 for use with the ATLAS missile. One flight had been made, and this also indicated that the warhead could adequately resist the missile environment.[13] The Mk 49Y1 Mod 0 for the ATLAS was released July 29, 1959.[14]

Mk 49 Mod 1 Warhead

Development of a Mk 49 inertial switch was ~~prepared~~ proposed in May 1958. This device would prevent warhead arming until the weapon had experienced a re-entry deceleration environment, and prevent premature detonation caused by tester malfunctions, procedural mistakes, or acts of sabotage.[15]

An amendment to the military characteristics was approved by the Military Liaison Committee October 21, 1958. This requested that a sensing device be built into the Mk 49 Warhead, to be actuated as late in the missile acceleration phase as possible, so as to reduce the possibility of nuclear detonation through accident or sabotage.[16] The Department of Defense had requested that this device be located so that access was difficult and time-consuming, and to protect against fire or other accidents. It was suggested that all existing Mod 0 Warheads be retrofitted with the device, thus resulting in the Mod 1.

Initial release of Mk 49Y1 Mod 1 and Mk 49Y2 Mod 1 Warheads was made in June 1959, and early production was attained in October 1959 by retrofit of Mod 0 Warheads. The Mk 49 Mod 1 was identical in all respects to the Mk 49 Mod 0, with exception of the inertial switch. This switch closed and latched after experiencing a force of 3 to 10 g's, with a total input of 10 g-seconds.

Three 28-volt direct-current inputs were required for arming. These could be received simultaneously, but, if in sequence, the order had to be as follows: (1) Continuous input to the chopper motor, (2) continuous input to the voltage converter, and (3) pulsed or continuous input to the boosting-gas valve.

(b)(3)

Two alternate methods of firing the trigger circuit were provided. The first was 28-volt direct current, and was used only in the air-burst option. The other was a 250-volt direct-current pulse, and could be used for either ground or air-burst.

Fuzing signals varied with the missile. JUPITER issued signals singly, in the above order, for arming, by cam-actuated switches on a safing and arming sequencer. Either a radar-air-burst or a contact-crystal signal was then received. The ATLAS and THOR fuzing system provided arming signals simultaneously and detonated the warhead by means of a baroswitch for air-burst option or piezoelectric crystals in the contact option.[17]

Mk 49 Mod 2 Warhead

The Mk 49 Mod 2 Warhead would have been incorporated in the Mk 3 re-entry vehicle in the ATLAS missile. The design would have been internally initiated, as in Mods 0 and 1. A decision to change to external initiators (see the Mk 49 Mod 3 Warhead) resulted in canceling the Mod 2, prior to production, in favor of the Mk 49 Mod 4.

Mk 49 Mod 3 Warhead

A product change proposal dated November 5, 1959 was designed to conserve reactor products.

(b)(1), (b)(3)

The Mk 49 Mod 3 Warhead was design released in January 1960, and authorization for use of this warhead with JUPITER and THOR missiles was issued March 11, 1960.[19] Early production by retrofit of Mk 49 Mod 1's was accomplished during March 1960, and new production started in June 1960.

(b)(1), (b)(3)

The electrical system consisted of the Mk 28 capacitor bank

Mod 0 Warhead, but a new warhead case and pressure cover would be provided. The case would have provisions for mounting nose cap and flare skirt, and the pressure cover would have to withstand the loading created by attachment to the missile. The portion of the warhead case exposed in the re-entry vehicle would be covered with ablation material.[22]

Sandia presented the development program definition of the XW-49-X1 to Albuquerque Operations Office March 16, 1959. Warhead development was directed toward design release in May 1959 and early production in February 1960. The new warhead case would contain modified Mk 49 Mod 0 plastic, same nuclear system, and Mk 49 Mod 1 firing set.[16]

Sandia presented Report SC4293(TR), Proposed Ordnance Characteristics of the XW-49-X1 Warhead, to the October 21, 1959 meeting of the Special Weapons Development Board.[24] The report noted that the warhead was being designed for incorporation in the Mk 3 re-entry vehicle. Carry-over components from the Mk 49 Mod 0 and Mod 1 Warheads would be used wherever possible. Significant changes included major redesign of warhead case section, new interface provisions, and improved sealing features.

(b)(3)

The report was accepted and forwarded to the Division of Military Application.[25]

(b)(1), (b)(3)

Design release was scheduled for January 1960 and early production for April 1960.

(b)(3)

This change would lengthen the warhead by 2.1 inches. The major diameter would be 20 inches plus ablating material, maximum length 57.9 inches plus electrical connectors, and the weight about 1640 pounds without ablation material and 1732 pounds with ablation material.

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Mk 49 Mod 5

On April 24, 1962, the Division of Military Application requested that the JUPITER warhead be provided with a permissive device to prevent unauthorized detonation.[32] Sandia stated that an expedited program could produce retrofit kits by late September 1962. To be compatible with the limited space available in the warhead firing section, separate environmental sensing devices and code switches would be installed.

A joint working group was established and met initially May 11, 1962. It was noted that this change would produce the Mk 49 Mod 5 and would increase the warhead weight by 12 pounds. The design was released September 25, 1962 and, within 4 days, two warheads had been retrofitted.[33,34] The Mod 5's were produced by retrofit of Mod 3's and involved replacing an inertial switch pack with a coded switch pack and substituting a new 2-piece pressure cover.[35]

Report SC4780(WD), Final Evaluation Report for the Mk 49 Mod 5 Warhead, was published in May 1964. This noted that permission had been given to deviate from normal development and production procedures in order to meet the retrofit date. Conversion hardware was produced from development rather than production drawings, the design group was given responsibility for acceptance of components, and all hardware, where possible, was 100-percent tested to establish its functional, electrical, structural and interchangeability characteristics.

The system operation of the Mk 49 Mod 5 was the same as the Mod 3, except that the environmental-sensing-device switches were not cross channeled, and therefore any switch failure would cause failure on one channel. Prior to launch, the coded switches were remotely armed to provide continuity through that part of the system.[36]

Glossary of Mk 49 Terms

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Adaption Kit -- Those items peculiar to the warhead installation less the warhead; namely, the arming and fuzing systems, power supply, and all hardware, adapters, and the like, required by a particular installation. Adaption-kit components are normally grouped into a complement, radars (if used), and power supply (if required).

Albuquerque Operations Office -- The local office of the Atomic Energy Commission (AEC) concerned with the operations of Sandia Corporation.

Boosting -- The technique of increasing the yield of a nuclear device by introducing deuterium-tritium gas into the implosion process to increase fission activity.

Capacitor -- A condenser that accumulates and stores electrical energy until time for detonation.

Chopper-Converter -- A device for transforming steady direct current into chopped pulses of energy.

Coded Switch -- A switch that cannot be operated until and unless the proper combination is dialed.

Contact Burst -- A weapon burst occurring on contact with target or terrain.

Crash Program -- A weapons program that has been expedited and its schedule speeded up. Generally produces weapons of lower quality or hand-made items that have not been fully tested or certified for use. See Emergency Capability Program.

Department of Defense -- The Armed Forces, i.e., the Army, Navy and Air Force.

Detonators -- Explosive devices which, when initiated ~~(see bridge wires)~~ by the X-unit, ignite the lens charges of the high-explosive sphere (which see).

Deuterium -- The hydrogen isotope of mass number 2.

Division of Military Application -- An AEC office that functions as liaison between the Military and weapons designers and producers.

(b)(1), (b)(3)

(b)(1), (b)(3)

Field Command -- The local office of the Armed Forces Special Weapons Project (Defense Atomic Support Agency), located on Sandia Base, Albuquerque, New Mexico.

Firing System -- The electrical system of the weapon that produces and applies a high-voltage current to the detonator.

Fuzing System -- The system that arms the weapon at the appropriate time and provides a firing signal to the firing system at the selected burst height.

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References

1. SRD Ltr, RS 1000/3215, Sandia Corporation to Albuquerque Operations Office, dtd 1/29/58, subject, Development Program Definition, XW-49. SC Central Technical Files, 49 Program, 2-.

2. SRD Report, RS 3466/81568, Ramo-Wooldridge Corporation to Distribution, dtd 12/16/57, subject, Latest Requirements for Modified XW-28. SC Central Technical Files, 49 Program, 1-.

3.

(b)(3)

4. SRD Report, RS 3423/161, Sandia Corporation to Distribution, dtd 8/61, subject, SC4928(WD), Final Evaluation Report for the Mk 49 Mod 1 and Mod 3 Warheads. SC Reports Files.

5. SRD Minutes, RS 3466/70076, Special Weapons Development Board to Distribution, dtd 4/23/58, subject, Minutes of 115th Meeting. SC Archives, Transfer No. 48217.

6.

(b)(3)

7. SRD TWX, RS 3466/70169, Division of Military Application to Albuquerque Operations Office, dtd 7/3/58. SC Central Technical Files, 49 Program, 1-.

8.

(b)(3)

9.

10. SRD Ltr, RS 1000/3270, Sandia Corporation to Albuquerque Operations Office, dtd 7/17/58, subject, Emergency Capability Release of the Mk 49Y1 Mod 0. SC Central Technical Files, 49 Program, 2-.

11. SRD Report, RS 1000/2554, Sandia Corporation to Distribution, dtd 8/29/58, subject, Initial Major Assembly Release, Mk 49Y1 Mod 0 Warhead. SC Central Technical Files, Mk 49 Mod 0 Warhead, 1-1 thru 4-9, General.

12. SRD Report, RS 1000/2578, Sandia Corporation to Distribution, dtd 4/29/59, subject, Major Assembly Release, Initial Release of the Mk 49Y2 Mod 0 Warhead. SC Central Technical Files, Mk 49 Mod 0 Warhead, 1-1 thru 4-9, General.

13. SRD Report, RS 1000/2588, Sandia Corporation to Distribution, dtd 7/2/59, subject, Major Assembly Release (Interim), Mk 49Y2 Mod 0 Warhead. SC Central Technical Files, Mk 49 Mod 0 Warhead, 1-1 thru 4-9, General.

14. SRD Report, RS 1000/2590, Sandia Corporation to Distribution, dtd 7/29/59, subject, Major Assembly Release, Mk 49Y1 Mod 0 Warhead. SC Central Technical Files, Mk 49 Mod 0 Warhead, 1-1 thru 4-9, General.

15. SRD Ltr, RS 1200/3259, Organization 1200 to Organization 1400, Sandia Corporation, dtd 5/27/58, subject, Inertial Switch for the W49. SC Central Technical Files, 49 Program, 1-.

16. SRD Ltr, RS 1000/3329, Sandia Corporation to Albuquerque Operations Office, dtd 3/16/59, subject, Development Program Definition, XW-49-X1. SC Central Technical Files, XW-49-X1, 1-, 2-.

17. SRD Negative, RS 3466/44047, Sandia Corporation to Distribution, dtd 9/1/59, subject, Weapon Data Sheet, Mk 49Y(1 or 2) Mod 0; Mk 49Y(1 or 2) Mod 1. SC Photo Negative Files.

18.

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19. SRD Report, RS 2330/59, Sandia Corporation to Distribution, dtd 1/29/62, subject, General Major Assembly Release of the Mk 49Y2 Mod 3 Warhead. SC Central Technical Files, Mk 49 Mod 3 Warhead, General.

20. Uncl Ltr, Field Command to Sandia Corporation, dtd 8/16/61, subject, SC4298(WD), Final Evaluation Report for the Mk 49 Mod 1 and Mod 3 Warheads. SC Central Technical Files, 49 Program, 1-.

21. SRD Ltr, Sandia Corporation to Division of Military Application, dtd 9/28/61, subject, Forwarding Letter for SC4298(WD). SC Central Technical Files, 49 Program, 7-.

22. SRD Ltr, RS 1000/3298, Sandia Corporation to Albuquerque Operations Office, dtd 10/3/58, subject, Weapon Development Program Number Assignment. SC Central Technical Files, 49 Program, 1-.

23.

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24. SRD Minutes, RS SWDB-59-120, Special Weapons Development Board to Distribution, dtd 10/21/59, subject, Minutes of 120th Meeting. SC Archives, Transfer No. 48217.

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